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THE ISTHMUS OF TEHUANTEPEC AND THE TEHUANTEPEC NATIONAL RAILWAY.

BY

EDMUND OTIS HOVEY.

On the 23d day of January, 1907, General Porfirio Diaz, President of the Republic of Mexico, with impressive ceremonies touched the electric button that set in motion a travelling steam crane which transferred from the steamship *Arizonian* at Salina Cruz, on the Pacific Ocean side of the Isthmus of Tehuantepec, to a waiting freight car the first bit of cargo to utilize the great new interoceanic route which has just been completed by the English construction firm of S. Pearson & Son under contract of partnership with the Mexican Government. On the following day the car of freight, accompanied by the President's special train, was taken across the Isthmus to Coatzacoalcos on the Gulf of Campeche, where the goods were put into the steamer *Louis Luckenbach* for conveyance across the Atlantic Ocean, thus actually opening to the commerce of the world a route which has been worked at spasmodically for a generation. The Mexican Government and the constructors of the railroad and port works, with Sir Weetman D. Pearson at their head, believe that the Tehuantepec line will do an enormous business and be a profitable enterprise from the start, and that it will compete successfully with the Panama Canal when that has been completed, or that at any rate there will be plenty of traffic for both routes.

The Isthmus of Tehuantepec, in the States of Vera Cruz and Oaxaca, Mexico, is only 125 miles across in a bee-line from the Gulf of Mexico to the Pacific Ocean. The vast mountain ranges and systems of the northern and central portions of North America converge rapidly in Mexico until, in this region, the hundreds of miles of breadth have dwindled to a few tens of miles and the thousands of feet of elevation have diminished to a pass only 800* feet above the sea at its highest point. This is the most northern break in the continental backbone of the mountains, and hence has long been prominent in the minds of the civil engineers of the world, as offering a practicable route for the economical transfer of interoceanic freight from the Atlantic to the Pacific and *vice versa*.

* The elevations cited in this article have been taken from Böse, "Excursions à l'isthme de Tehuantepec." X Congr. Géol. Int., Guide au Mexique, XXXI.

Study of the map shows that the route from the Atlantic and Gulf ports of North America across the Isthmus of Tehuantepec to the west coast of North America and other north Pacific ports is from 1,000 to 1,900 miles shorter than the route across the Isthmus of Panama, while from Liverpool the difference is from 800 to 950 miles in favour of Tehuantepec. The average saving in distance from New York is about 1,250 miles, which means a reduction in time of five days at the usual rate of speed of a freight steamer, and a still greater economy of time for sailing vessels. This saving, however, will be partly offset by slower handling of freight across Tehuantepec than across Panama.

Although it is now admitted that Hernan Cortes, the Spanish explorer and conqueror, probably never conceived the idea of building a canal across the isthmus, his letters to his Royal Master show that he appreciated the importance and advantages of a water communication between the oceans and that he had some knowledge of the Tehuantepec region—in fact, he crossed the isthmus on his expedition into Honduras. Cortes was so much pleased with the country that he asked and obtained from Emperor Charles V an extensive grant of land, comprised in the haciendas of Tarifa, Chicapa, and La Venta. These estates remained in the possession of descendants of the conqueror for several generations; and even to this day they are known as Las Marquesanas, or the haciendas of the Marquis, Cortes having been made Marquis of Oaxaca by the Emperor.

Fragmentary surveys were made by the Spaniards in the sixteenth and eighteenth centuries, which are said to be more than merely creditable pieces of work for their periods. Time after time it has been proposed to construct a canal across the isthmus, the first of these plans seeming to have been formulated by Agustin Cramer, an engineer of repute and Governor of the fortress of San Juan de Ulua, Vera Cruz, who was sent out in 1774 by the Viceroy de Bucareli to survey the isthmus. Since 1847 many concessions for railroads or rail and water routes have been granted by the successive Governments of Mexico, some to American, some to European, and some to mixed companies, but bad luck seemed ever to camp on the trail of an individual or a company trying to open an avenue of interoceanic communication across Tehuantepec. Captain James B. Eads, a famous American civil engineer, proposed a scheme which received much popular notice for building a railway that was to be fitted up for receiving a ship bodily from one ocean, carrying it across the Isthmus and setting it afloat again in the other, but the plan was too costly to be feasible.

The first rails of a transisthmian road were laid between 1878 and 1882 under a concession granted to Edward Learned of New York. Only 35 kilometers (22 miles) had been built when the work was abandoned and the concession declared forfeited. Then Don Delfin Sanchez obtained a concession and managed to construct about 73 kilometers (46 miles) by April, 1888, when his grant was annulled. He had contracted to finish the whole road by February 28, 1885, but two-thirds of the task remained to be touched when his connection with the enterprise ceased. The next contract was with Edward McMurdo on the basis of a loan floated by the Mexican Government in London, Paris, and Amsterdam in 1888. McMurdo died before the contract could be carried out; but it was not until January, 1892, that his widow relinquished her claim on the Mexican Government. On the 27th of February, 1892, an agreement was signed by the Government, and Messrs. Hampson, Stanhope and Corthell, in accordance with which the line was to be finished by September, 1893. Funds, however, gave out, and again was the contract cancelled and the work stopped. Fifty-nine kilometers (37 miles) of road remained to be constructed, and, a new loan having been negotiated, a contract was signed December 6, 1893, by which Mr. Chandos S. Stanhope, of the preceding firm of contractors, agreed to complete the work in nine months.

The road was finally opened to travel in 1895 after forty-five years of spasmodic effort and the expenditure of \$32,000,000, but it was realized that the route was not in physical condition for the accommodation of interoceanic traffic, and that such traffic could not be expected for the railway until after safe and commodious harbours had been provided at the terminals of the road. Coatzacoalcas, on the Gulf side, could only receive vessels of less than twelve feet draught of water on account of the bar at the mouth of the river, and there were no docks or wharves; while at Salina Cruz, the Pacific terminus, there was nothing but an open roadstead, which offered an extremely insecure anchorage for vessels. These considerations and the necessity for providing for the efficient operation of the road and harbours after everything should be in order for business led to a revised and more comprehensive grasp of the situation on the part of the Government.

The present history of the Tehuantepec route dates from 1896, when an enabling act was passed by the Federal Congress which authorized some proposed contracts with a private corporation for carrying on the whole enterprise. The firm of S. Pearson & Son, Ltd., was the one which President Diaz and his Ministers selected for

the work, the firm having won favour in Mexico through having completed the great drainage canal for the basin of Mexico City and the extensive port works at Vera Cruz. The first contracts with the Pearsons for the Tehuantepec work were signed in 1898, but those now in force were not ratified until May, 1902, and modifications in these were made two years later. The history of the Tehuantepec concessions has always been one of constant changes. The agreements between the Mexican Federal Government and the Pearson firm provide for a joint partnership for fifty-one years from July 1, 1902, between the contracting parties for the construction, maintenance, and operation of the Tehuantepec National Railway and the ports of Coatzacoalcos and Salina Cruz.

As outlined in "Modern Mexico" for March, 1905, the corporate capital is \$7,000,000, furnished equally by the partners, and the disposition of the annual earnings is as follows: (1) Payment of operating expenses, maintenance of track, etc., and formation of a reserve fund for repairs; (2) Payment of interest on loans; (3) Payment to the two partners of an interest of 5 per cent. on the capital furnished by them; (4) Refundment of losses in previous years which were charged to capital; (5) Payment of interest at 5 per cent. per annum on the capital devoted to the Coatzacoalcos port works; (6) The surplus to be divisible between the Government and the contractors as follows: During the first thirty-six years 65 per cent. to the Government and 35 per cent. to the contractors; during the next five years, 68½ per cent. to the Government and the remainder to the contractors; during the next five years 72½ per cent. to the Government and the remainder to the contractors; in the last five years, 76½ per cent. to the Government and the remainder to the contractors." The sum advanced by the Mexican Government for the prosecution of the work has amounted to about \$33,000,000 gold.

The new route begins active life with a contract for the entire freight of the American-Hawaiian Steamship Co., which assures a business of at least 500,000 tons of sugar and other cargo. The Company has been operating by way of the Straits of Magellan, but with the completion of the Tehuantepec railway and harbours two new lines go into commission, one from New York to Honolulu and the other serving the coastwise traffic between Salina Cruz and the Pacific ports of the United States. When the Union Iron Works of San Francisco have finished the three ships now building for the American-Hawaiian Co., four 8,000-ton steamers will ply between New York and Coatzacoalcos, six 12,000-ton boats between Salina

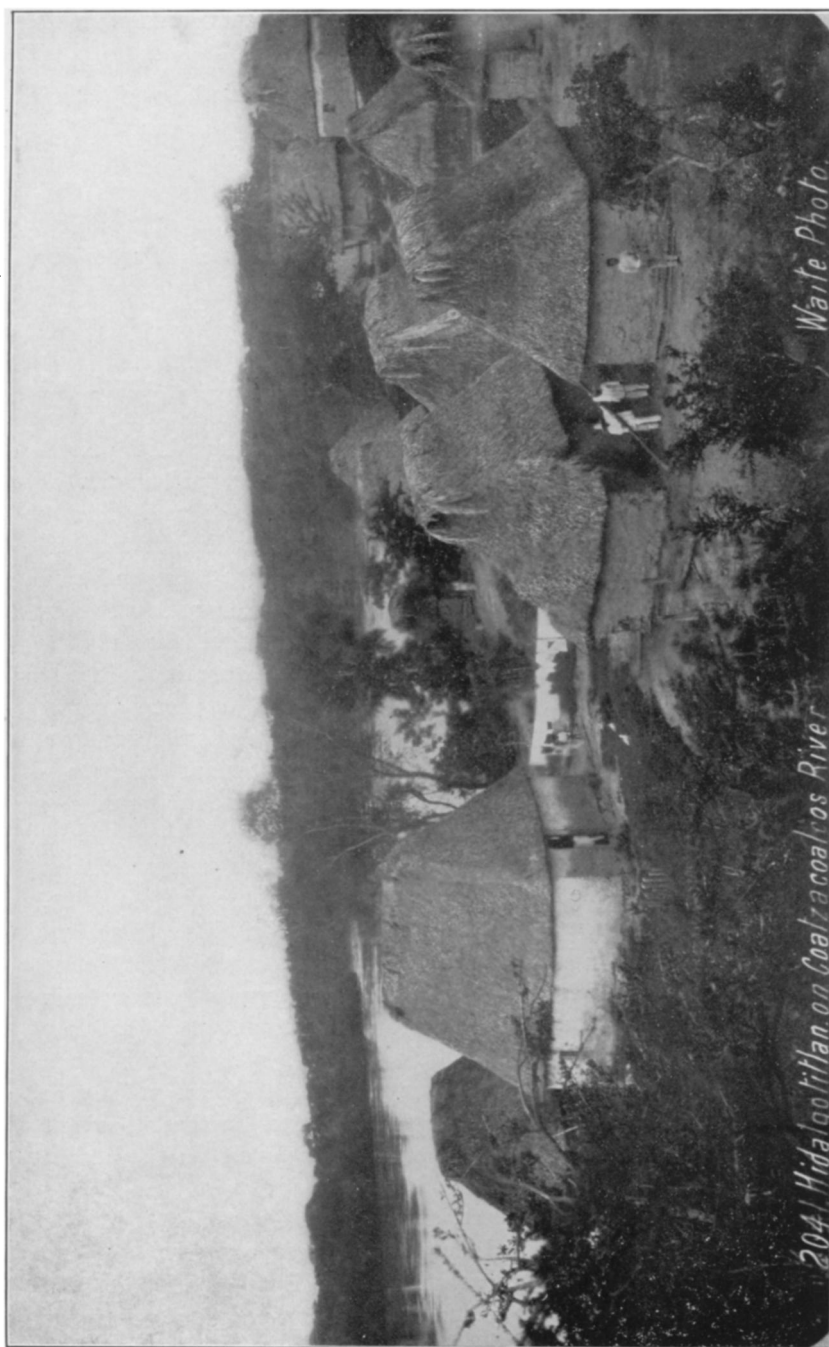


FIG. 1.—ALONG THE ROUTE OF THE TEHUANTEPEC RAILWAY. A NATIVE VILLAGE OF THE TEHUANA INDIANS ON THE COATZACOALCOS RIVER.

Cruz and Honolulu and two 6,000-ton ships will care for the coast-wise trade. The Magellan route will be abandoned, if not already given up at the present writing. This contract is binding only until the Panama canal is opened to vessels, when it may be cancelled by either party. The maximum rates of passenger and freight have been fixed by the Mexican Government, and are: First-class passenger about four cents per kilometer (five-eighths of a mile), Third-class, two cents. First-class freight will pay eight cents per ton per kilometer, while the cheapest cargo will cost three cents per kilometer-ton. These rates are in Mexican silver, which is approximately one half the value of American currency.

The railway consists of the main line, 310 kilometers long, from one harbour to the other, and a branch 28 kilometers long from Juile to San Juan Evangelista. The road is of standard gauge, with rails 80 pounds to the yard on the main line, laid on ties of creosoted pine, native hardwood and California redwood. Heavy steel tie-plates are used on all the ties. The roadbed is now in excellent condition throughout, about half of the line being ballasted with gravel and most of the remainder with broken rock. Seventeen kilometers have "natural" ballast. The bridges are all substantially built in permanent fashion, with stone abutments and heavy steel spans. The bridge, 560 feet long over the Jaltepec River at Santa Lucrecia, is the largest on the line. It is a massive five-span structure suited to the support of the heaviest trains. The management is looking forward to and preparing for the double-tracking of the road within a few years.

An important item of the expense of maintenance on the Isthmus is the treatment of the vegetation on and along the right of way. Trees and brush are kept cut down on either side of the track, but mechanical means are inadequate for the economical destruction of the weeds on the roadbed, and the operating company has adopted a chemical which is applied hot under pressure by means of a steam atomizer from a tank car and kills roots as well as superficial growth. It is said that the Tehuantepec was the first railway in Mexico to use oil-burning locomotives. The oil has been brought to Coatzacoalcos by steamer from the Texas fields, but important oil-bearing sands, supposed to be of Tertiary age, have been tapped on the Gulf side of the Isthmus, and these are expected to supply all the needs of the railway and the ports. There is a great 1,500,000 gallon storage tank at Coatzacoalcos that receives the oil, and from this it is distributed to 6,500 gallon tanks at convenient places along the road.

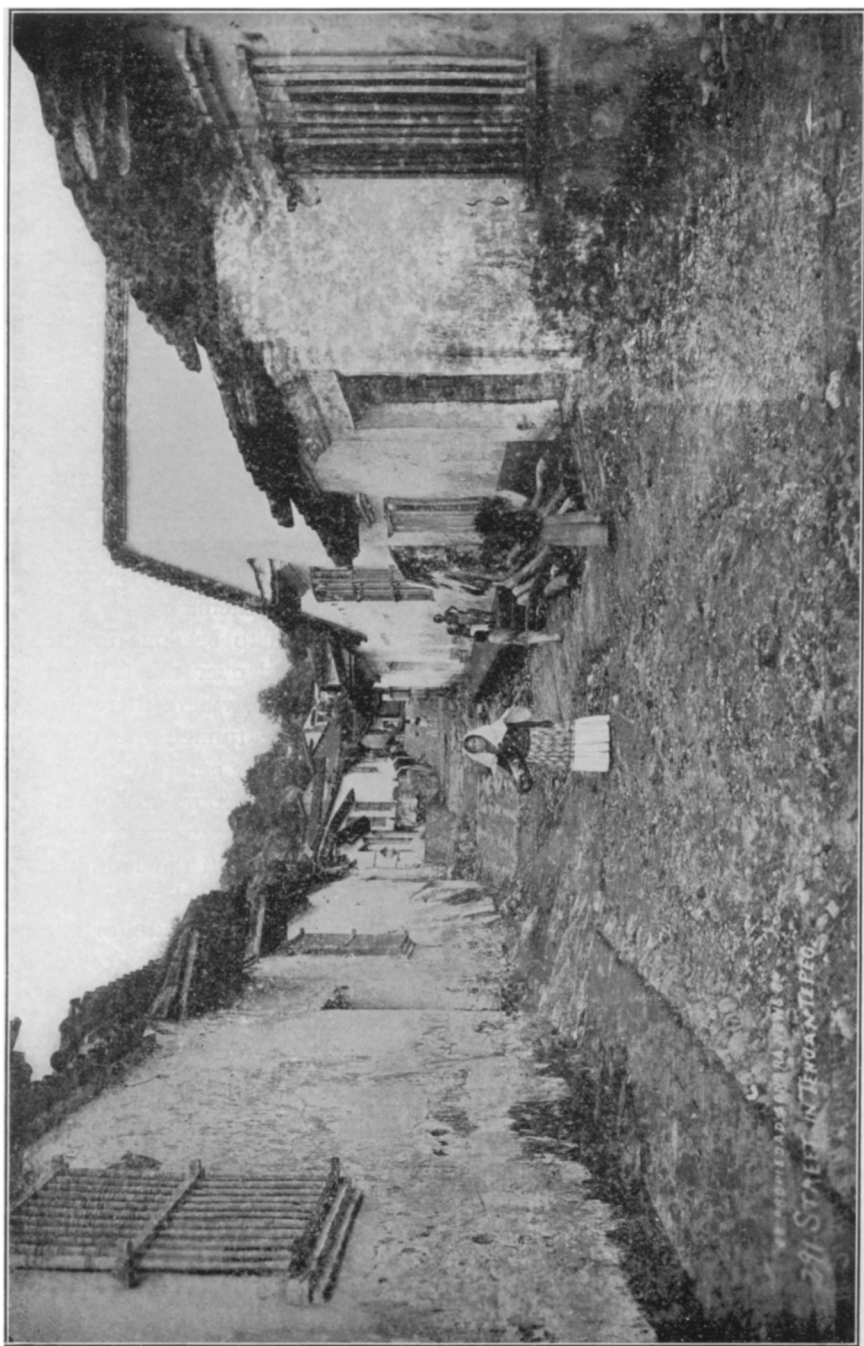


FIG. 2.—A SIDE STREET IN TEHUANTEPEC, THE CHIEF TOWN OF THE TEHUANA INDIANS.

Car-building and repair shops and the administrative offices of the company have been established at Rincon Antonio, a town which has been called into existence by the needs of the railway. The site of the town is a broad plain about 575 feet above the sea, surrounded by mountains and enjoying a comparatively good climate by reason of the winds that constantly sweep across the Isthmus. It is 204 kilometers (128 miles) from Coatzacoalcos. Rincon Antonio is a new town, and therefore not picturesque; but it is clean and flourishing, and the Indian inhabitants, who live by themselves, appear contented. The general manager of the railroad, Mr. J. N. Galbraith, is an American, and most of the other chief officials are either Englishmen or Americans. They all live in a group of handsome, commodious houses on a hill overlooking the town and commanding a fine view of the surrounding country. Another group of comfortable dwellings has been provided for the clerks and other skilled employés of the company. Life at Rincon Antonio is said to be very pleasant. The building and repair shops are up to date in their equipment, all power being transmitted by electricity, and there is a well-appointed foundry connected with them.

Although much heavy construction work had to be done in the Malatengo Cañon for a distance of 9 miles and over the Chivela Pass (800 feet above the sea) for about 24 miles, where there are two horseshoe curves, several bridges, and one tunnel, the most stupendous pieces of engineering connected with the enterprise have been the providing of terminal facilities and safe harbours at Coatzacoalcos and Salina Cruz. At the former place the great Coatzacoalcos River, which drains the whole northern side of the Isthmus, forms a natural harbour of unlimited capacity, which was discovered by an expedition sent out by Cortes. The mouth of the river was obstructed by a bar on which there was only 12 feet of water at low tide. Two stone jetties, each about 1,300 meters (0.8 mile) long, have been thrown out into the sea, which are expected to maintain the depth of 10 meters (32.8 feet) which has been given the channel by dredging.

Wharves aggregating a frontage of more than 3,280 feet have been built, so that vessels drawing 33 feet of water can lie alongside. On and beside the wharves several great warehouses and an extensive system of tracks have been installed beside the river bank, so that powerful travelling steam cranes can take cargo from the ship, and, with one handling, deposit it directly upon freight cars or in the warehouses, as need may demand. The roofs of the warehouses have been built with removable hatches, to permit the direct transfer of freight from ship to storage and *vice versa*.

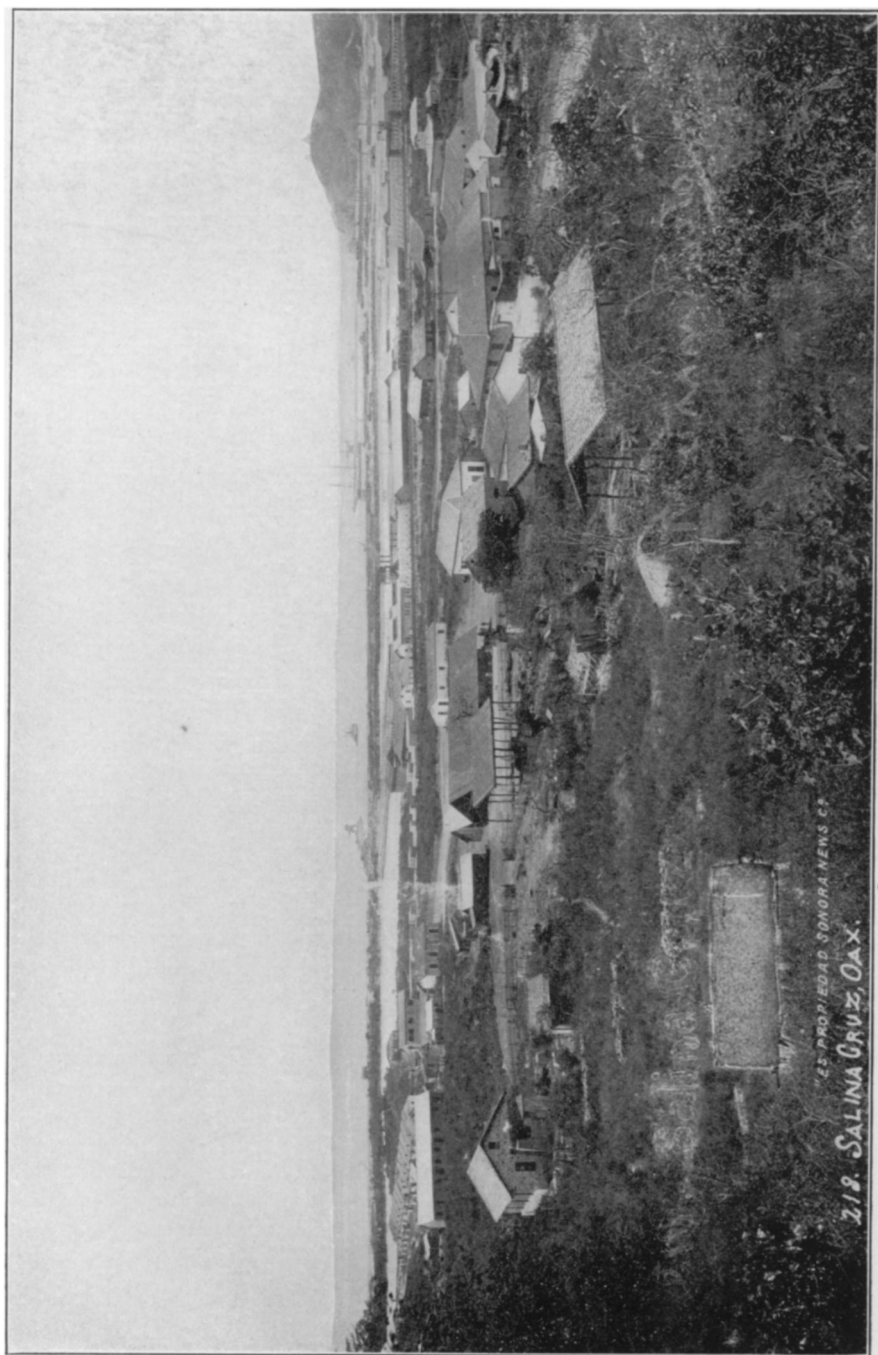


FIG. 3.—SALINA CRUZ, OAXACA, MEXICO. THE NEW TOWN AT THE PACIFIC TERMINUS OF THE TEHUANTEPEC RAILWAY.

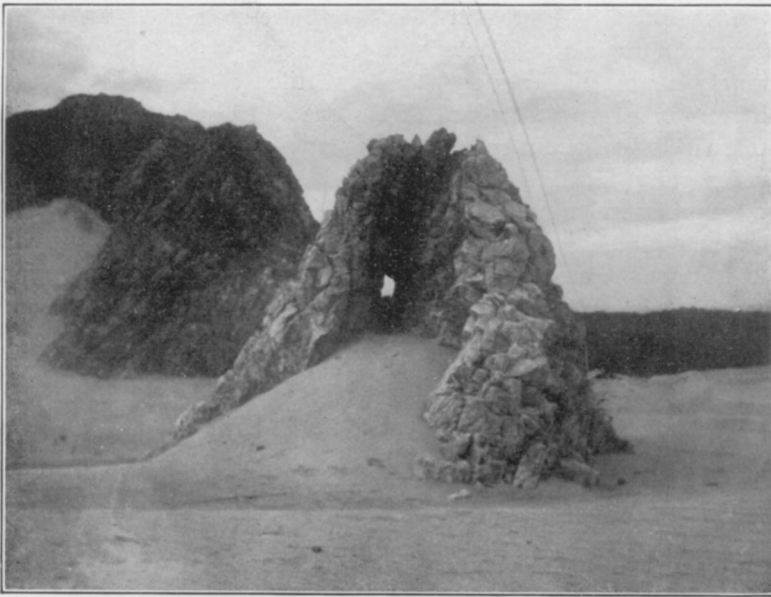
The terminal freight yard occupies swamp land which has been filled in with clean gravel, incidentally greatly improving the healthfulness of the town. When completed, this yard will cover 480,000 square yards of land which has been gained by the use of 931,000 cubic yards of filling and will be gridironed with tracks aggregating more than 13 miles.

On the Pacific coast there was no natural harbour that could be used as the terminal for the railway. The Tehuantepec River, the largest of the streams along this part of the western slope, is a small stream when compared with the Coatzacoalcos, and it loses itself in a series of lagunas, or ponds, which gave no promise of the economical construction of a safe and commodious port; hence it has been necessary for the Mexican Government and the Pearsons to make an artificial harbour for the Pacific terminus of the Tehuantepec Railway, and this has been done at Salina Cruz. Formerly there was an open roadstead at this point, which acted as an insecure stopping-point for the coast steamers, and a little town eked out a miserable existence on the small trade which was carried on. The present town is an entirely new one, which has been built by the Pearsons on a healthful site overlooking the new harbour that occupies the place once utilized for streets and buildings.

The new harbour is double, consisting of an outer portion, or harbour of refuge, and an inner basin. The outer harbour has been formed by the construction of two massive breakwaters thrown out into the sea. The eastern of these is five-eighths of a mile long, while the western is only about one-half as long. The opening between them is 220 yards wide, with 66 feet of water at low tide. The inner harbour has been formed by excavating the site of the old town of Salina Cruz so as to form a basin which is now five-eighths of a mile long, and 700 feet wide, with 33 feet of water at low tide. Warehouses and tracks have been provided here on the same extensive scale as at Coatzacoalcos.

In the northwest corner of the basin there is under construction a dry dock about 600 feet long and 100 feet wide, with the bottom 30 feet below low tide. At the time of our visit in October, 1906, this was nearly finished, but an immense amount of excavating remained to be done to connect the dock with the harbour. The dry dock has been built of concrete, a material that has entered largely into the construction of all new harbour works at both terminals.

At the western side of the harbour granitic cliffs form a bold promontory surmounted by a lighthouse, at the base of which the prevailing winds from the north have piled up the sand like great



FIGS. 3 AND 4.—SALINA CRUZ, OAXACA, MEXICO. CLIFFS OF MICROGRANITE BESIDE ENTRANCE TO HARBOUR; SHOWING PECULIAR DISINTEGRATION AND THE DRIFTS OF SAND. FROM PHOTOS MADE FOR THE AMERICAN MUSEUM OF NATURAL HISTORY BY E. O. HOVEY.

snow drifts. The drifts, however, are not permanent, and a visitor during the season when the south winds prevail would find the cliffs barren of the sand, which has been blown over the breakwater into the new harbour, rendering constant dredging necessary to maintain the works.

The natives inhabiting the Isthmian region belong to the Tehuana tribe of Indians, and are noted for their graceful figures and carriage, the intelligence, and even beauty, of their features, and the small size of their well-formed hands and feet. They still preserve many of their ancient customs and wear their picturesque costumes.

On festival occasions a girl's dowry is draped about her neck in the shape of five, ten, and twenty-dollar American gold-pieces linked together to form a necklace. Sometimes the value of these necklaces amounts to hundreds, and even thousands, of dollars, those belonging to one girl whose photograph we saw being worth not less than \$3,000 in currency.

Tehuantepec is the chief town of the Isthmus and of the Tehuana. It is a quaint, old city of some 5,000 inhabitants, clustering around a pretty plaza, one side of which is, of course, bounded by the market and its bazaars.

Aside from municipal buildings, there is scarcely a house in town more than one story in height, and the residence streets show the usual tropical characteristics of heavy-walled houses with strongly-barred windows and low, flat, tiled roofs. A short two-minutes' walk from the plaza brings one to the poorer quarters of the town, where one may see, among other things, the weaving of textiles going forward in primitive fashion, and the carding, spinning, dyeing and weaving of cotton goods, which are done now by hand and in the same manner as for generations. The Tehuana women are very fond of ornamenting their garments with machine embroidery in yellow and blue thread, and we found Singer sewing-machines, which they use for this purpose, in some most unexpected places. The Singer sewing-machine, indeed, is one of the most widely distributed of all American inventions. Modes of transportation throughout the region are still primitive, and at many places on the Isthmus we saw in use bullock carts of the heaviest and clumsiest construction.

Passing the geology of the region in rapid review, we have, according to Böse,* at Salina Cruz, ancient acid intrusive igneous rocks in the shape of granite in and to the east of the village itself; while microgranite forms the main portion of the precipitous and

* E. Böse, *loc. cit.*

forbidding ridges to the west along the coast. The belt of these rocks is about three miles wide. About ten miles north, across a stretch of alluvial and coastal plains, the railroad enters, at Tehuantepec, a zone of gneiss with associated felsite, intrusive granite and crystalline schists, but the pyroxenic gneiss predominates. This zone, which is about two miles wide, is considered to be of Archæan age. Much of the microgranite has been quarried for concrete work at Salina Cruz; while the felsite of Dani Lieza, near Tehuantepec, has furnished the great blocks of stone needed for the jetties. North of Tehuantepec the railroad traverses another sandy, alluvial (?) plain for 15 miles and then enters an area 2.5 miles across of muscovite granite and microgranite, in the midst of which is the village of San Jerónimo. Beyond San Jerónimo the road crosses the last bit of the coastal plain region of the Pacific, a sandy stretch of eight miles, and enters the zone about 22 miles wide of gneiss, crystalline schists, quartzites and phyllites, which forms the real Archæan backbone of the continent here. It is the heart of the Sierra. These crystalline rocks are associated with metamorphic limestone which is thought to be of Middle Cretaceous age, though exact determination is impossible through absence of fossils. The gneiss and crystalline schists are much folded and contorted and the limestone has been folded and faulted.

Beyond the zone of gneiss, and separated therefrom by a ridge of heavy-bedded crystalline limestone, is a broad zone (32 miles) of much-contorted argillaceous schists and sandstones which are referred with probability to Lower Cretaceous age. Our section has now reached Paso de Buques (165 km. from Coatzacoalcos), a short distance beyond which there occurs a rather narrow belt of Middle Cretaceous limestone. From 162 km. to Chinameca (37 km. from Coatzacoalcos) there are occasional exposures of Upper Miocene beds of sand, clay, and gravel containing fossils. Several broad anticlinal and synclinal folds are indicated by the positions of the strata.

Near Aguas Medias, 97 km. from Coatzacoalcos, in the midst of this broad Tertiary plain, rise some low but precipitous mountains of massive limestone which is regarded as being of Cretaceous age. This has been quarried extensively for the jetties at Coatzacoalcos and for ballasting the railroad. From Chinameca to the Gulf there seem to be only sands of Pleistocene or modern age, the latter being probably for the most part destroyed dunes. Extensive marshes border the Gulf.